Beyond X™ Switchboard

Installation and Maintenance Manual

LS ELECTRIC

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1. SAFETY PRECAUTIONS

Make sure to follow the safety precautions to prevent accidents or hazards, and ensure safe and proper use of the product.

Precautions are classified into three categories: Danger, Warning and Caution. Refer to the descriptions below for their meanings.

DANGER	Failure to follow this danger sign may result in immediate serious injury or death.
WARNING	Failure to follow this warning sign may result in immediate serious injury or death.
CAUTION	Failure to follow this caution sign may result in minor injury or product damage.

The meanings of the markings affixed to the product are as follows:

This marking warns users of potentially hazardous conditions or operations. When this marking is displayed, read the accompanying instructions carefully and follow them to avoid hazardous situations.

This marking indicates a risk of electric shock under certain conditions and requires careful attention.

DANGER

Do not touch live parts (such as conductors or terminal connections) while current is flowing.
Failure to follow this instruction may result in electric shock, causing serious injury or death.

1. SAFETY PRECAUTIONS

⚠ WARNING

1. **Do not operate, inspect, or repair unless you are a qualified expert.**
   Failure to follow this instruction may result in malfunction, injury, or electric shock.

2. **Do not open doors or protective covers while current is flowing.**
   Failure to follow this instruction may result in electric shock.

3. **Do not insert metal bars while current is flowing.**
   Failure to follow this instruction may result in injury or electric shock.

4. **Do not use a tape measure while current is flowing.**
   Failure to follow this instruction may result in injury or electric shock.

5. **Ensure that the charging current is fully discharged before performing maintenance.**
   Failure to follow this instruction may result in injury or electric shock.

6. **Tighten bolts and screws to the specified torque.**
   Failure to follow this instruction may cause overheating or fire.

7. **Do not lift the shielding plate of live parts while current is flowing.**
   Failure to follow this instruction may result in electric shock.

8. **Do not use damp or water-soaked insulating rods when opening or closing the fuse.**
   Failure to follow this instruction may result in injury or electric shock.

9. **Do not open the secondary circuit of the current transformer while current is flowing.**
   Failure to follow this instruction may cause high voltage generation and fire.

10. **When opening the disconnecting switch, open the lower circuit breaker first. When closing, engage the disconnecting switch first, then the lower circuit breaker.**
    Failure to follow this instruction may result in a short circuit or injury due to arc heat.

11. **Remove all foreign objects (such as tools, wires, bolts, or washers) after installation, inspection, or maintenance.**
    Failure to follow this instruction may cause a short circuit or fire.

1. SAFETY PRECAUTIONS

⚠ WARNING

12. **Turn off the circuit breaker and keep it in the test position during inspection.**
    Failure to follow this instruction may result in electric shock.

13. **Turn off the upper, lower, and bus-tie circuit breakers and keep them in the test position.**
    Failure to follow this instruction may result in electric shock.

14. **Use an appropriate measuring instrument when checking the status after turning off the power.**
    Failure to follow this instruction may result in electric shock.

15. **Do not use bolts longer than the specified length.**
    Failure to follow this instruction may cause a short circuit or fire.

16. **Do not wipe the surface of energized equipment with a wet cloth after completing installation, inspection, or maintenance.**
    Failure to follow this instruction may result in electric shock.

⚠ CAUTION

1. **Do not modify or change the circuit at your own discretion.**
   Failure to follow this instruction may result in malfunction or failure.

2. **Do not disassemble, alter, or modify the product at your own discretion.**
   Failure to follow this instruction may cause a short circuit or overheating, and the product's quality and reliability cannot be guaranteed.

3. **Do not store the product in locations exposed to flooding or high humidity.**
   Failure to follow this instruction may cause insulation breakdown or deterioration of product performance.

4. **Do not store indoor switchboards outdoors.**
   Failure to follow this instruction may cause deterioration of product performance due to moisture or environmental factors.

2. TRANSPORTATION

2-1 Handling caution markings (wooden packaging box)

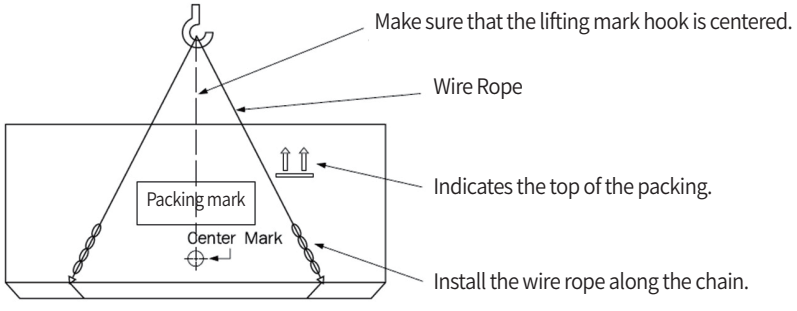
Make sure to comply with the handling instructions such as caution markings affixed on the packaging box. The handling instructions indicated on the packaging box are as follows:

[Table 1] Caution Markings on Packaging

Graphic	Caution	Handling instructions
	Center	This mark indicates the center of the product.
	Sling Here	Use the wire rope on this mark.
	This Side Up, Do Not Tilt	Keep the product upright as indicated by this mark, and do not tilt the packaging box.
	Fragile, Handle With Care	Handle the packaging box with care. Do not shake, drop, or subject it to impact, as it is fragile.
	Keep Dry, Keep Indoors	Make sure that the contents of the packaging box are not exposed to rain or moisture. Keep the packaging box stored indoors at all times.
	Do Not Stack	Do not stack items on top of the packaging box.
	Avoid Moisture	Ensure that no moisture accumulates inside the packaging box. Store the product in a dry location.

2-2 Unloading procedure

1) As shown in [Figure 1], securely hang the wire rope on the packaging box, following the chain mark.

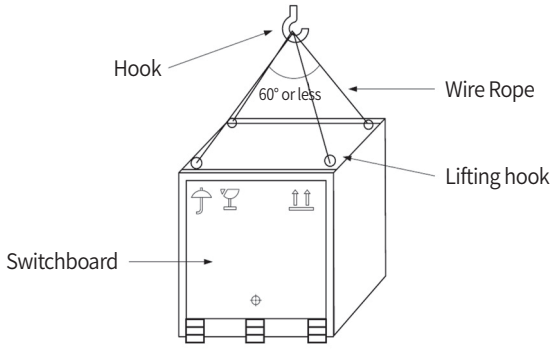


[Figure 1] Lifting Method

2. TRANSPORTATION

2-2 Unloading procedure

2) As shown in [Diagram 2], hang the wire rope diagonally, ensuring the rope angle does not exceed 60°.



[Figure 2] How to Hang the Wire Rope

3) Center the crane hook over the packaging box to lift it horizontally.

4) Lift the packaging box slowly.

5) Apply tension to the wire rope, using a normally twisted wire rope.
Ensure the wire rope can safely bear the weight of the packaging box.

6) Use four lifting hooks.
Fasten the wire ropes to the designated attachment points, extending diagonally from each hook.

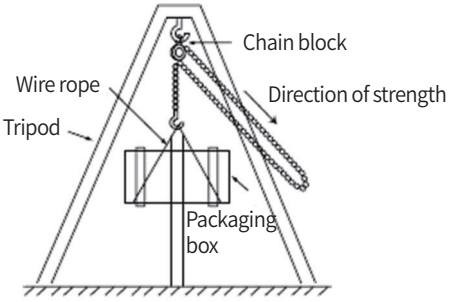
7) Do not stack or transport the packaging box during unloading. This is extremely dangerous.

8) Exercise caution when pushing or pulling the packaging box.

2-3 Lifting method

1) The contents of the packaging box may shift eccentrically during lifting. To prevent this, install the wire rope aligned with the chain marks at the four corners, even for lightweight packaging boxes.
Ensure that the bottom crate of the packaging box bears the load when attached to the wire rope.

2) Lift the packaging box approximately 11.81 in. (30 cm) and check that it remains level when paused. Verify that the wire rope is properly tensioned and not twisted before continuing the lift.
[Figure 3] illustrates lifting the packaging box using a chain block.



[Figure 3] How to Lift Using a Chain Block

2. TRANSPORTATION

2-4 Transportation by vehicle, etc.

1) Loading method

a) Ensure that the packaging box is firmly fixed and stabilized during loading to prevent it from falling during transportation.

b) Load the packaging box with its center positioned at the bottom.

c) Load the packaging box to form a balanced and uniform load on the loading plate.

d) If stacking more than two items, place bulky and heavy items first, and place light and small items on top.

e) Prevent the packaging box from moving or vibrating by using nails, bolts, or ropes to secure it and prevent it from falling.

f) Secure the packaging box with sufficient force to prevent loosening due to shock or vibration during transport.

2) Use of waterproof film, etc.

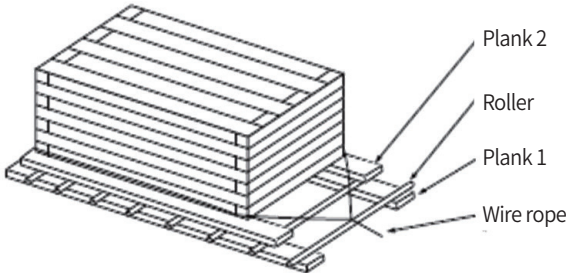
a) For products marked “Keep Dry,” cover the packaging box with a waterproof film, even if it is not raining or snowing.

b) Cover the packaging box to prevent rainwater from pooling on the waterproof film.

c) Secure the edges of the waterproof film to prevent fluttering or loosening during transport.

2-5 Transport using rollers

1) Avoid transporting the packaging box by roller whenever possible.
If unavoidable, ensure impacts to the packaging box are minimized using the method shown in [Figure 4].



[Figure 4] Transport Using Rollers

2) If the packaging box must be transported using rollers, first lay Plank 1 on the ground and place rollers of equal size on Plank 1 at regular intervals. Then, place Plank 2 above the rollers to support the packaging box, place the packaging box on Plank 2, and secure it with a wire rope.

3) Attach the wire rope as close as possible to the packaging box, except when using special tools.

4) Position Plank 2 properly under the packaging box, ensuring that the load is evenly distributed across Plank 2 and the rollers.

5) Place rollers at intervals of 15.74 in. (40 cm), ensuring at least two rollers are positioned on Plank 1 to allow them to function effectively.

6) Use rollers made of iron pipe, iron bar, or oak wood.
It is essential to use a sufficient number of rollers to support the load of the packaging box.

2. TRANSPORTATION

2-5 Transport using rollers

7) It is recommended to use oak wood for plank 1.

8) Select Plank 2 based on its size, strength, and material to ensure it can support the load of the packaging box.

9) If the packaging box cannot be transported using rollers, it may be moved using a greased steel sled on a steel plate. Do not drag the packaging box directly on the ground in this case.

2-6 Transport using a forklift

1) Prepare lumber with a length of 2.36 in. (60 mm) or longer to support the packaging box during forklift transport.

2) Observe the following precautions when transporting the packaging box using a forklift:

a) Do not stack items for transport.

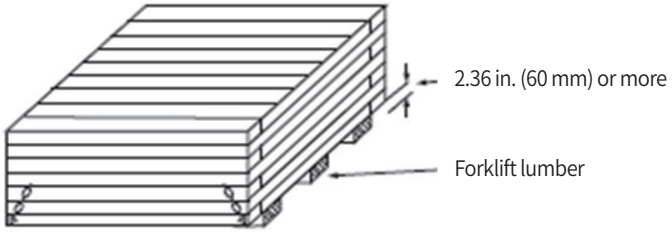
b) Keep the packaging box balanced at all times.

c) Maintain a movement speed below 4 km/h (average walking speed).

d) If the packaging box is too large for the forklift operator to operate safely, use an alternative transportation method.

e) Ensure the forklift forks are long enough to fully engage the packaging box.

f) Use a forklift that is capable of bearing the load of the packaging box.



[Figure 5] Transport Using a Forklift

3. STORAGE

⚠ CAUTION

1. **Do not store the product in locations exposed to flooding or high humidity.**
   Failure to follow this instruction may cause insulation breakdown and deterioration of product performance.
2. **Do not store indoor switchboards outdoors.**
   Failure to follow this instruction may cause deterioration of product performance due to moisture or other environmental factors.

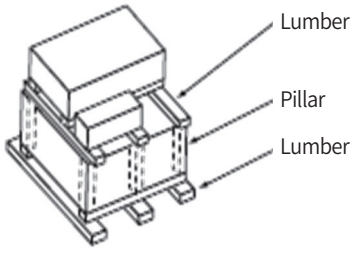
3-1 Storage location

Store the packaging box indoors in a dry environment, free from dust accumulation.
If outdoor storage is necessary, do not leave the packaging box outside for more than two weeks.
Ensure the following conditions are met during outdoor storage:

1) Store the packaging box in a well-drained and dry location
2) Ensure storage is above the flooding level, considering the expected water level in case of flooding.

3-2 Storage method

1) Inspect the packaging box for any damage incurred during transport.
2) Keep the product and all installation accessories in a secure location to prevent loss.
3) Store the packaging box at least 2.36 in. to 4.72 in. (60 to 120 mm) above the floor to avoid direct contact.
4) When stacking packaging boxes:
   a) Stack boxes of the same size and category whenever possible.
   b) Place heavier boxes on the bottom and lighter ones on top.
   c) Insert timbers between the top and bottom boxes to ensure the load of the top box is applied to the columns of the bottom box, as shown in [Figure 6].
5) Apply a protective cover to shield the packaging box from environmental changes. Operate a space heater if necessary to maintain proper conditions.
6) If the storage location is accessible by vehicles or is near working areas, designate it as a restricted area.
7) Ensure adequate ventilation when storing in a small warehouse.
8) If environmental conditions become unsuitable for storage (e.g., high temperature, high humidity) even with a protective cover, create ventilation openings to maintain proper conditions.
9) When stacking packaging boxes, ensure that the shipping marks are visible.



[Figure 6] Stacked Storage Method

3. STORAGE

3-3 Product storage and usage environment

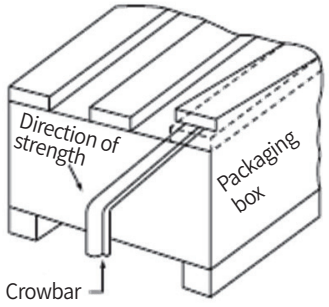
Store and use the product under the following environmental conditions.

Items		Description
Environment	Ambient temperature	32 °F to 104 °F (0 to 40 °C, no ice or frost)
	Relative humidity	85 % (average over 24 hours), 80 % (average over 1 month)
	Surrounding environment	No corrosive gas, flammable gas, oil residue, dust, etc.
	Elevation, vibration	Below 1000 m above sea level, 5.9 m/sec 2 (= 0.6 g) or less
	Ambient air pressure	70 to 106 kPa
	※ Environmental considerations 1. Select a well-ventilated location with no high temperature or high humidity. If the temperature at the installation site fluctuates widely, install ventilators or dehumidifiers, as dew condensation may occur even under relatively low humidity conditions. 2. Avoid locations where dangerous goods are produced or stored, as these pose a risk of fire or explosion. 3. Avoid areas exposed to salt, corrosive substances, or toxic gases. 4. Install the product in a location not at risk of flooding or water leakage, including potential leaks from overhead floors or water pipes. 5. Do not install flammable gas, water, or fuel pipes in the substation room.	

4. UNPACKING

4-1 Unpacking method

1) When unpacking the packaging box, slowly remove the top plate first, followed by the side plates in succession if applicable.
2) Use a crowbar to remove nails or a saw to cut the wood, but do not break the packaging box with a hammer.
3) Do not insert the crowbar too deeply to prevent damage or deformation of the contents. Avoid applying excessive force to the lower end of the crowbar to minimize internal stress on the packaging box. [Figure 7] illustrates the correct use of a crowbar.
4) After unpacking, arrange and clear away all planks and lumber with protruding nails to prevent injury.



[Figure 7] How to Unpack the Packaging Box with Crowbar

4-2 Checklist when unpacking

1) Check whether the product is broken, deformed or damaged.
2) Check the type and quantity of the product and accessories for installation to make sure that no parts are missing.
3) Check ACB (more than 3000 A) and VCB, since they are separately packed and shipped, if necessary.

5. INSTALLATION

⚠ WARNING

1. **Tighten bolts and screws using the specified torque.**
   Failure to follow this instruction may cause overheating and result in fire.

2. **Do not use bolts longer than the specified length.**
   Failure to follow this instruction may cause a short circuit and result in fire.

3. **Remove all foreign objects (tools, wires, bolts, washers) after installation.**
   Failure to follow this instruction may cause a short circuit and result in fire.

4. **Do not wipe the surface of energized equipment with a wet cloth after completing installation, inspection, or maintenance.**
   Failure to follow this instruction may result in electric shock.

⚠ CAUTION

1. **Do not modify or change the circuit at your own discretion.**
   Failure to follow this instruction may cause malfunction or failure.

2. **Do not disassemble, alter, or modify the product at your own discretion.**
   Failure to follow this instruction may cause a short circuit or overheating, and the product's quality and reliability cannot be guaranteed.

5-1 Installation of switchboard

1) Installation site

Inspect the floor, columns, walls, and switchboard layout schematics of the installation site before proceeding.

2) Floor cleaning

Check the level of the installation surface. Grind any severely uneven areas to create a horizontal surface, and clean the installation area thoroughly.

3) Switchboard Installation

Install the switchboard following the order shown in the exterior view, taking care not to damage operation switches, indicators, meters, or other devices protruding from the switchboard surface.
Connect the panels, clean both the interior and exterior of the switchboard, and inspect for any damage or broken components during installation.

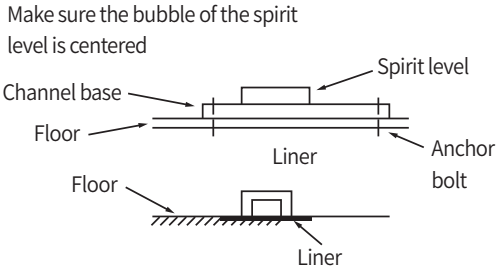
5. INSTALLATION

5-1 Installation of switchboard

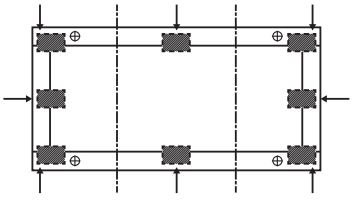
4) Adjustment of the liner

Adjust the height using a liner, ensuring that the channel base is properly aligned with the horizontal surface. Measure the height at 1m intervals using a spirit level.

Position the liner so it is aligned as closely as possible with the outer edges of the channel base, and secure it using mortar that does not shrink.
It is recommended to install the liner around the anchor bolts at wide intervals near the center of the channel base.



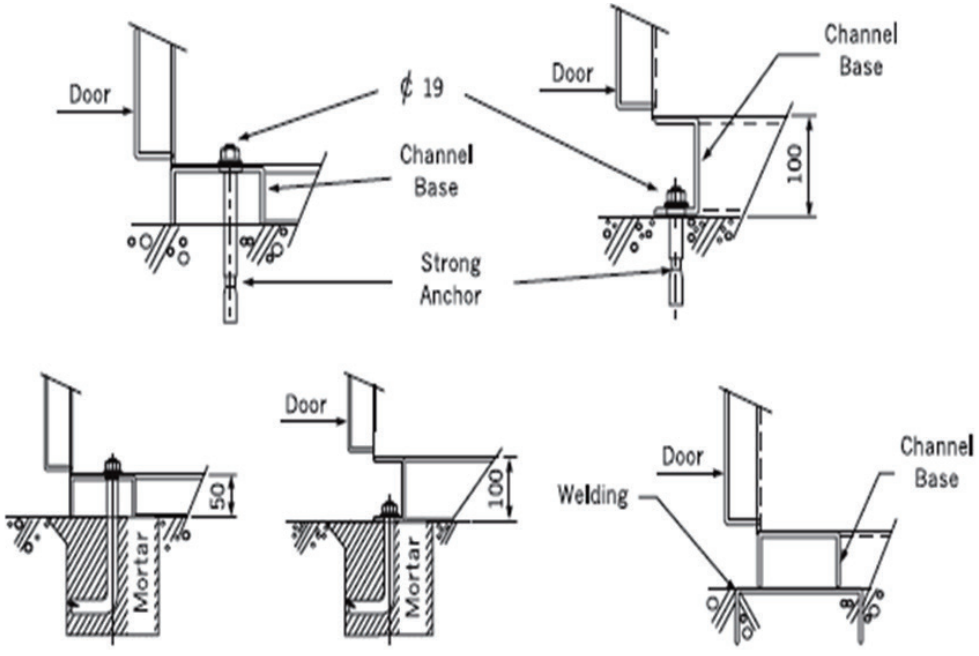
[Figure 8] Setting the Liner



[Figure 9] Level Measurement Points

5) Installation of anchor bolts

Ensure the liner is properly positioned before installing the anchor bolts. Drill holes in the anchor bolt locations of the channel base and secure the prepared anchor bolts completely.
Refer to the diagrams for the correct bolt dimensions and installation details.



<Indoor type> <Outdoor type> <In case of Welding>

[Figure 10] Example of Anchor Bolt Installation

5. INSTALLATION

5-2 Electrical connection

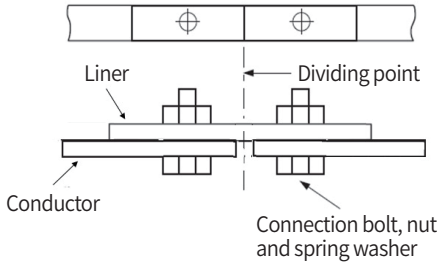
1) Connection of main bus and grounding bus

Open the main bus room cover, and connect the main bus and grounding bus to link the divided switchboard, following the assembly diagram.

The connection piece required for the busbar connection is attached to the end of the busbar. Use bolts and nuts that correspond to the pre-machined holes on the busbar during assembly.

[Table 2] Bolt Tightening Torque When Connecting Busbar

Bolt specification	Torque (kg f · cm)
M6	70 to 100
M8	200 to 245
M10	350 to 490
M12	600 to 850
M16	1500 to 2040



[Figure 11] Connection of Main Bus and Grounding Bus

■ CU (copper) and Al (aluminum) are the same.
■ Torque tolerance is - 0 % to +22 - 42 % (applying maximum tightening torque)
■ For the strength of M6 or bigger bolts (spring washers), apply 8.8 (high-tensile bolts).

2) Connection of operation wiring

Connect the control wiring to the relay terminals inside the panel (“Y terminals”). Each Y terminal is marked with a serial number; ensure the wiring is connected to the matching terminal.

Fasten the screws using the torque specified in [Table 3].

[Table 3] Torque When Tightening Screws

Bolt specification	Torque (kg f · cm)	Bolt specification	Torque (kg f · cm)
M3	6 to 8	M5	30 to 40
M3.5	10 to 13	M6	50 to 65
M4	15 to 20		

5. INSTALLATION

5-3 Prevention of invasion by mice and Insects

Rodents, snakes, or insects inside the switchboard while the bus is energized may cause short circuits and, in some cases, serious system failures.
Completely seal all entrances, such as pits, using barriers, and keep the switchboard doors closed unless access is necessary.

5-4 Cleaning inside the cabinet and inspection points

Keep the interior of the switchboard clean at all times. Clean the busbar at least once a year after turning off the power. Inspect the bus, automatic connection parts, and surrounding areas for dust accumulation. Remove any unnecessary items inside the switchboard.

Never use a wet cloth or water when cleaning electrical parts. Always use a dry cloth for cleaning.

5-5 Inspection after fault recovery

Ensure that all checks are completed and the faulty parts are fully restored or replaced before resuming operation.

1) Check the wiring.
2) Check related equipment (operation check).

5-6 Inspection of connection part

Mechanical and electrical parts secured with bolts and nuts may loosen due to vibration. In such cases, retighten the bolts and nuts.

The following parts must be fastened:

1) Cap of the operation fuse.
2) Wires of the main circuit (primarily bus) and auxiliary circuit.
3) Attachment bolts of each device.

6. INSPECTION AND MAINTENANCE

DANGER

1. **Do not touch live part (conductor and terminal connecting parts) while current is flowing.**
   Electric shock may result in serious injury or death.

WARNING

1. **Do not operate, inspect, or repair the equipment unless you are a qualified expert.**
   Failure to follow may cause malfunction, injury, or electric shock.
2. **Do not open doors or protective covers while current is flowing.**
   Failure to follow may cause electric shock.
3. **Do not insert metal objects while current is flowing.**
   Failure to follow may cause electric shock.
4. **Do not use a tape measure while current is flowing.**
   Failure to follow may cause electric shock.
5. **Do not lift the shielding plate of live parts while current is flowing.**
   Failure to follow may cause electric shock.
6. **Do not open the secondary side of the current transformer for instruments while current is flowing.**
   Failure to follow may induce high voltage and cause fire.
7. **Ensure that all charging current is fully discharged before performing maintenance.**
   Failure to follow may cause injury or electric shock.
8. **Tighten bolts and screws using the specified torque.**
   Failure to follow may cause overheating and fire.
9. **Do not use damp or water-soaked insulation rods when opening and closing the fuse.**
   Failure to follow may cause in electric shock.
10. **When opening the disconnecting switch, open the lower circuit breaker first.**
    Failure to follow may cause a short circuit and injury from arc heat.

6. INSPECTION AND MAINTENANCE

⚠ WARNING

11. **Turn off the circuit breaker and keep it in the test position during inspection.**
    Failure to follow may result in electric shock.

12. **Turn off the upper and lower circuit breakers, as well as the bus tie circuit breaker, and keep them in the test position.**
    Failure to follow may result in electric shock.

13. **Use an appropriate measuring instrument when checking the system status after turning off the power.**
    Failure to follow may result in electric shock.

14. **Do not use bolts longer than the specified length.**
    Failure to follow may cause a short circuit and fire.

15. **Do not wipe the surface of energized equipment with a wet cloth after completing installation, inspection, or maintenance.**
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⚠ CAUTION

1. **Do not modify or change the circuit at your own discretion.**
   Failure to follow may cause malfunction or failure.

2. **Do not disassemble, alter, or modify the product at your own discretion.**
   Failure to follow may cause a short circuit or overheating, and the product's quality and reliability cannot be guaranteed.

6-1 Considerations when establishing an inspection plan

The detail and frequency of the inspection should be determined, taking into account the various conditions described below.

1) Equipment usage time

In general, since old equipment is more likely to fail than new equipment, it is necessary to subdivide the inspection details and shorten the period.

6. INSPECTION AND MAINTENANCE

6-1 Considerations when establishing an inspection plan

2) Importance of equipment

Some equipment is critical, while other equipment is relatively less important. Therefore, the scope and frequency of inspections should be adjusted according to their importance.

3) Environmental conditions

The environment of the equipment installation site determines inspection and maintenance requirements. For example, equipment lifespan can be reduced due to insulator deterioration, metal corrosion, or overheating, which are affected by factors such as location (indoor or outdoor), dust levels, ventilation, humidity, presence of gases, and vibration.

Equipment that is overloaded due to frequent use, increased load, or deteriorated environmental conditions should be inspected more frequently, and preventive measures should be implemented.

4) Failure history

Equipment that frequently fails due to poor environmental conditions should be inspected more often to prevent recurrence.

5) Load condition

Equipment that is overloaded due to frequent use, increased load, or adverse environmental conditions should be inspected more frequently, and preventive measures should be implemented.

6-2 Classification of inspection

Constraint conditions must be considered during inspections. The table below provides details of constraint conditions and regular inspection requirements.

Constraint condition / Classification of inspection	Door opening/ closing	Separation of covers withdrawal	Uninter-rupted power supply	Circuit power off withdrawal	Bus power off withdrawal	Breaker withdrawal specification	Inspection period
Daily inspection	-	-	0	-	-	-	Daily basis
	0 (1)	-	0	-	-	-	On monthly basis
Daily inspection	0	-	-	0	-	0	On semi-annual basis On yearly basis
					-		
	0	0	-	0	0 (2)	0	Every 3 years
Temporary inspection	0	0	-	0	0	0	-

※ Notes:

1. When power is not supplied, the door can be opened during inspection. However, it is recommended to open the door for inspection on a monthly basis.
2. Although power outage of the bus is highly unlikely, it is recommended to inspect the bus every three years.

6. INSPECTION AND MAINTENANCE

6-2 Classification of inspection

1) Daily inspection

A daily inspection is conducted to maintain the proper function of the switchboard. Follow the procedure described below:

a) Daily inspection does not require opening doors or removing covers. Inspect for abnormal sounds, odors, or visible damage from the exterior of the switchboard according to the specified inspection items.
b) If any abnormality is detected, open the switchboard door and assess the severity of the issue.
c) Unless the abnormal condition prevents safe operation of the equipment, record the details of the abnormality and use the information as reference data during regular inspections.

2) Regular inspections

A regular inspection is conducted according to a planned schedule to check and maintain the function of the switchboard.

a) Before performing an inspection, turn off the power to the equipment. Disassemble the equipment if necessary.

3) Temporary inspection

A temporary inspection should be conducted if an abnormality is found during a daily inspection or if a major incident occurs.

a) In the event of a major incident, check the normal operating condition of peripheral equipment, and inspect the interior of the circuit breaker if it has been activated.

6-3 Checks before inspection

1) Thorough preparation

Learn to perform first-aid measures, keep the work area tidy, and ensure the safety of equipment and machinery.

2) Review by circuit diagram

After the power system is restored, check the various power sources in the cabinet, the current in the primary side of the circuit breaker, and the grounding wire.

3) Contact

Ensure that all relevant departments can be reached quickly and clearly.

4) Checking no power supply and safety measures

When checking the main circuit, review the following items for safety.

a) Open the relevant circuit breaker and disconnecting switch, and discharge voltage from the main circuit.
b) Verify the absence of voltage using a voltage detector, and ground the circuit wherever necessary.
c) Withdraw the circuit breaker to ensure it is disconnected, and attach a sign indicating “Inspection in Progress.”
d) Operate the disconnecting switch after locking it.
(If a locking device is not available, attach a sign stating “Inspection in Progress.”)
e) If power is restored and current flows in the incoming panel or bus communication panel, apply the measures described in steps c) and d) to the switchgear of the other party.

6. INSPECTION AND MAINTENANCE

6-3 Checks before inspection

5) Caution on current and voltage

When inspecting the connection part of the condenser and cable, discharge the residual charge and ground it.

6) Prevention of incorrect operation

Lock the power supply and attach a caution sign to prevent unintended operation.

7) Preparation of protective devices for insulation

Wear protective equipment appropriate for the rated voltage, such as insulated gloves, safety helmet, insulated boots, and safety clothing.

8) Measures against infestation by rodents or insects

Take appropriate measures to prevent rodents, insects, or snakes from entering the cabinet.

6-4 Checks after inspection

1) Removal of ground wires

Ensure that all grounding applied for inspection purposes is removed after the inspection is completed.

2) Final inspection

Perform the following checks during the final inspection:

a) Verify that no personnel remain inside the cabinet.
b) Ensure that any equipment temporarily installed for inspection has been removed.
c) Check that all fastening bolts are properly secured. (Use a separate checklist.)
d) Confirm that no tools or materials are left inside the cabinet.
e) Check for signs of rodent or insect infestation.

3) Inspection records

For daily, regular, or temporary inspections, record all inspected and repaired items, the situation, and the date of any failures. Use these records as reference data for subsequent inspections.

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

Perform the inspection as described below, and follow the items listed for important maintenance tasks, such as cleaning insulators and tightening loose bolts.

1) Switchboard

No.	Target	Inspection point	Purpose	Inspection details	Notes
1	Enclosure	Outside (door, enclosure)	Tightening loose bolts	Are the bolts on the back cover loose or did any parts fall on the floor?	
			Damage	Are there any soft spots or damage on the packaging?	
			Stain	Are there signs of rain or water leaks in the cabinet?	In particular, pay attention to the condition of the main circuit insulator.
			Ventilation	Are the ventilation filters coming loose?	
			Installation	Are there any slopes or twists caused by abnormal floor subsidence or uplift?	Be cautious of impacts on the disconnection part of the circuit breaker's main circuit.
		Door	Tightening loose bolts	Are any bolts or similar components, such as hinges and stoppers, loose?	
		Partition	Tightening loose bolts	Have any previously tightened bolts become loose or fallen onto the floor?	
			Damage	Is there any deformation or damage?	
		Main circuit disconnection part (including ground contact)	Tightening loose bolts	Have any previously tightened bolts become loose or fallen onto the floor?	For details, refer to the circuit breaker instruction manual.
			Damage	Are the bushings and wires free from damage, broken wires, or deformation?	
			Contact	Is the contact in good condition?	
			Discoloration and stain	Is there any discoloration of the conductor due to overheating? Are any foreign objects or dust present?	
2	Device	Control circuit disconnection part	Tightening loose bolts	Are bolts on the operating and fixed sides loose?	
			Damage	Are plug wires damaged, disconnected, or deformed?	
		Shutter	Contact	Is the contact in good condition?	Be cautious when connecting to the circuit breaker.
			Damage	Is there any deformation due to loosened bolts, and have any bolts fallen onto the floor?	
		Limit switch	Damage	Is the lever or body damaged or deformed?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

1) Switchboard

No.	Target	Inspection point	Purpose	Inspection details	Notes
2	Device	Withdrawal device (breaker, unit, etc.)	Tightening loose bolts	Have any previously tightened bolts become loose or fallen onto the floor?	Be cautious when connecting to the circuit breaker.
				Is the nameplate deformed?	
			Damage	Is the rail or stopper deformed?	
			Operation	Does the withdrawal device move to the designated location?	
		Device operation (disconnecting switch, etc.)	Tightening fastened bolts	Is there any deformation or short circuit due to loose bolts?	
3	Bus and support	Bus	Tightening loose bolts	Have any previously tightened bolts become loose or fallen onto the floor?	
			Damage	Is the insulator cracked, damaged or deformed?	
			Discoloration	Is there any discoloration of the connection part or insulator due to overheating?	
		Insulator, bushing, isolation support	Damage	Is the insulator cracked, damaged or deformed?	
			Discoloration	Is there any discoloration of the insulator due to overheating?	
			Stain	Are there any foreign matter/objects or dust attached?	
		Flexible bus	Damage	Are there any disconnected lines or bent parts?	
			Discoloration	Is there any unusual discoloration on the surface?	
4	Main circuit incoming/ withdrawal part	Connection part of a closed bus	Tightening loose bolts	Have any previously tightened bolts become loose or fallen onto the floor?	When measuring insulation resistance, ensure that electronic and semiconductor devices are not short-circuited.
			Damage	Is outdoor packaging deteriorated?	
			Discoloration	Is there any discoloration of the connection part or insulator due to overheating?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

1) Switchboard

No.	Target	Inspection point	Purpose	Inspection details	Notes
4	Main circuit incoming/ withdrawal part	Bushing	Tightening loose bolts	Has any tightened bolt become loosened?	When measuring insulation resistance, ensure that electronic and semiconductor devices are short-circuited.
			Damage	Is the insulator cracked or damaged?	
			Discoloration	Is there any discoloration of the connection part or insulator due to overheating?	
			Stain	Are there any foreign matter/objects or dust attached?	
		Cable terminal part or connection part	Tightening loose bolts	Has any tightened bolt become loosened?	
			Damage	Is the insulation tape peeled off or damaged?	
			Compound off	Is the compound peeled off?	
			Stain	Are there any foreign objects or dust attached?	
5	Wiring	General wire	Tightening loose bolts	Has any tightened bolt attached to the connection part become loosened?	
			Damage	Is the insulation coating of the wires connected to the operational unit damaged?	
			Discoloration	Is there any discoloration of the insulator due to overheating?	
6	Terminal block	Outside	Tightening loose bolts	Has any tightened bolt in the terminal part become loosened?	
			Damage	Is the insulator cracked or damaged?	
			Discoloration	Is there any discoloration of the insulator due to overheating?	
			Stain	Is the terminal unit discolored due to stains or foreign objects?	
7	Grounding	Earthing terminal, ground wire and grounding bus	Loosened bolt tightening	Are the bolts in the connection part securely fastened and properly grounded?	
			Stain	Is there any stain or foreign matter attached to the terminal unit?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

1) Switchboard

No.	Target	Inspection point	Purpose	Inspection details	Notes
8	Device general	Insulation resistance measurement	Isolation resistance	For the insulation resistance of the main circuit and control circuit, record the initial values and measurement conditions during installation, and document each item when inspecting equipment. · Set the insulation resistance tester to DC 1000 V or higher for high-voltage circuits, and DC 500 V or higher for lowvoltage circuits. Clean the insulator with a dry cloth.	
		Control circuit (sequence) general wire	Normal operation of the circuit	· Checking via the switchgear Verify that voltage and current are being normally supplied from the PT and CT by operating the switchgear.	
				· Operation test by control switchgear Verify that the device operates normally by checking the switchgear operation status while manipulating the control switchgear.	
				· Check operation using a relay Test whether the circuit breaker is blocked by operating the relay's main contact. Verify that the open/close indicator light, fault blocking alarm, and fault indicator operate normally, and confirm the operation of the relay's fault indicator and auxiliary contactor.	
		Interlock Outside general	Electrical Mechanical	Verify whether the interlock meets the required conditions according to the control circuit.	
			Operation check	Verify the operation of the interlock device.	
				Verify whether the limit switch is operating normally.	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

For inspection intervals, disassembly, and adjustment of each device, refer to the instruction manual for each device.

2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
1	Main circuit breaker	Appearance	Tightening loose bolts	Has any tightened bolt become loosened in the main circuit terminal unit?	
			Damage	Is the insulator cracked, damaged or deformed?	
			Discoloration	Is there any discoloration on the terminal or contact due to overheating?	
			Stain	Are there any foreign objects or dust on the insulator?	
			Leak	Is the vacuum level low?	
				Has the gas pressure decreased? (For GCB)	
			Wear	Is the contact worn? (For parts that can be inspected externally)	
		Open/close light of the open/close indicator	Operation	Does it work normally?	
		Open/close meter	Operation	Does it work normally?	
		Control device	Damage	Are the springs rusted, damaged or deformed?	
				Are the connections or pins bent, or are they short-circuited?	
				Is the coil disconnected?	
		Low pressure control circuit	Tightening loose bolts	Have any tightened bolts become loose in the control circuit terminal unit?	
			Contact	Is the contact of the control circuit plug intact?	
2	Breaker for wiring	Appearance	Tightening loose bolts	Have any tightened bolts become loose in the terminal unit?	
			Damage	Is the insulator cracked, damaged or deformed?	
			Discoloration	Is there any discoloration on the terminal or contact due to overheating?	
			Stain	Are foreign particles or dust present on the insulator?	
		Control device	Operation	Is the opening/closing operation normal?	
			Indication	Is the opening/closing display normal?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
3	Disconnecting switch AC load switchgear	Appearance	Tightening loose bolts	Have any tightened bolts become loose in the main circuit terminal unit?	
			Damage	Is the insulator cracked, damaged or deformed?	
				Is the control lever damaged?	
				Are the springs rusted, damaged or deformed?	
			Discoloration	Is there any discoloration on the terminal unit contact?	
			Stain	Are foreign particles or dust present on the insulator?	
		Main contactor	Tightening loose bolts	Does the fixed contact ever open by itself in magnetic contacts?	
				Do the springs exhibit elasticity in inertial contacts?	
		Control device	Contact	Has the contact become rough?	
			Damage	For the interrupter switch, is the arc-quenching chamber functioning normally?	
				Are the springs rusted, damaged or deformed?	
				Are connections or pins bent or shortcircuited?	
			Operation	Are the connection components, such as the clamp, functioning normally?	
				Do the input, opening, and closing operations operate smoothly?	
			Indication	Is the opening/closing indicator operating properly?	
		Low pressure control circuit	Tightening loose bolts	Are there any bolts in the terminal part that have loosened?	
		Safety check	Operation	In the case of hook operation, does the interlock function properly when the disconnecting switch is open?	
4	Current transformer	Appearance	Tightening loose bolts	Are there any bolts in the terminal unit that have loosened?	
			Damage	Is the insulator cracked or damaged?	
				Is the iron core rusted or damaged? (Applicable only if it can be checked externally.)	
			Discoloration	Is the bushing terminal part discolored?	
			Stain	Are there any foreign objects or dust attached to the bushing?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
5	Transformer	Appearance	Tightening loose bolts	Has any bolt in the terminal unit become loose?	
			Damage	Is the bushing cracked, damaged or deformed?	
				Are the oil level gauge and thermometer damaged or broken?	
				Are the coil and insulator damaged (for dry-type units)?	
			Discoloration	Is the insulator discolored due to overheating (for dry-type units)?	
			Leak	Is oil leaking (for inflow-type units)?	
			Stain	Are there any foreign objects or dust attached to the bushing?	
		Oil level gas pressure gauge	Indication	Is the oil level at the proper position (for inflow-type units)?	
				Has the gas pressure dropped (for nitrogen-filled units)?	
		Thermometer	Indication	Is the indication normal?	
			Operation	Is the alarm circuit functioning normally?	
		Cooling fan	Stain	Is the filter clogged?	
			Operation	Does it operate normally?	
				Check the operational state during automatic operation.	
6	Main circuit fuse	Appearance	Tightening loose bolts	Have any bolts in the terminal part or contacts become loose?	
			Damage	Are the fuse box and insulator cracked or deformed?	
			Discoloration	Is the terminal part of the fuse box and fuse holder discolored?	
			Stain	Are there any foreign objects or dust attached to the insulator?	
			Operation	Does the disconnecting switch have any problems during opening or closing operations?	
7	Lightning arrester	Appearance	Tightening loose bolts	Has any bolt in the terminal unit become loose?	
			Damage	Is the insulator cracked, damaged or deformed?	
				Are the lead wire terminals damaged?	
			Stain	Are there any foreign objects or dust attached to the insulator?	

6. INSPECTION AND MAINTENANCE

6-5 regular inspection items

2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
8	Neutral ground resister of the current transformer	Appearance	Tightening loose bolts	Has any bolt in the terminal unit become loose?	
			Damage	Is the insulator cracked, damaged or deformed?	
				Are the lead wire terminals damaged?	
			Stain	Are there any foreign objects or dust attached to the insulator?	
9	Power condenser	Appearance	Tightening loose bolts	Has any bolt in the terminal unit become loose?	
			Damage	Is the bushing cracked or broken, or is the enclosure deformed?	
			Stain	Are there any foreign objects or dust attached to the bushing?	
10	Indicator	Outside	Tightening loose bolts	Has any bolt in the terminal unit become loose?	
			Damage	Is the bushing cracked or broken, or is the enclosure deformed?	
			Stain	Is any foreign matter/object or dust attached?	
			Indication	Has the zero-point adjustment been performed correctly?	
		Mechanical part	Damage	Are the springs rusted, damaged or deformed?	
			Operation	Is there a loss of friction in the brake system?	
				Is there any looseness or eccentricity in the shaft?	
		Accessories	Damage	Are the sorter, multiplier, and auxiliary CT burned out or disconnected?	
		Recording part	Operation	Does the pen correctly record on the operation sheet?	
		Recording sheet	Residual quantity	Are the remaining ink and recording sheet adequate?	
11	Relay	Appearance	Tightening loose bolts	Has any bolt in the terminal unit become loose?	
				Has the soldered part come off?	
			Damage	Have the packings come off?	
				Is the cover damaged?	
			Stain	Is any foreign object or dust attached?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
11	Relay	Contact part Contact	Damage	Has the contact surface become rough?	
				Are there any cases of shorted contacts, disconnections, or dielectric breakdown?	
				Is there any coil burnout, intermediate short circuit, or dielectric breakdown?	
			Contact	Is the contact connected properly?	
				Is the CT secondary circuit still closed when the nest plug is pulled out?	
		Operational unit	Operation	Do the rotating device and indicator of the operational unit return normally?	
				Is there any looseness in the gear due to friction?	
				Is there any rattling in the rotating part?	
			Tightening loose bolts	Is the correction tap stable (not vibrating)?	
			Correction	Are the correcting tap and correcting lever set correctly?	
12	Operation switch Transfer switch	Appearance	Tightening loose bolts	Has any bolt in the terminal part become loose?	
			Damage	Is the insulating material cracked, damaged or deformed?	
				Is the spring cracked, damaged or deformed?	
			Operation	Is the opening and closing operation functioning normally?	
				Are the lock device and residual contact device functioning normally?	
		Contact part	Indication	Is the handle displaying correctly?	
			Damage	Is the contact damaged?	
13	Indicator light Indicator Alarm device	Appearance	Tightening loose bolts	Has any bolt in the terminal part become loose?	
			Operation	Are the operation and the flashing normal?	
		Accessory resistor	Discoloration	Is there any discoloration due to overheating of the terminal?	
			Location	Is the control wire close to the heating part?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
14	Test terminal	Appearance	Looseness	Is the terminal part loose?	
			Contact	Is the contact in good condition?	
			Damage	Is the insulator cracked, broken or deformed?	
15	Resistor heater for control circuit	Appearance	Looseness	Is the terminal connection loose?	
			Discoloration	Is there any discoloration on the terminal due to overheating?	
			Location	Is the control wire close to the heating part?	
16	High pressure vacuum contactor	Appearance	Looseness	Are any bolts loose in the main circuit terminal unit?	
			Damage	Is the insulator cracked, damaged or deformed?	
			Discoloration	Is there any discoloration on the terminal and contact due to overheating?	
			Stain	Are there any foreign objects or dust on the insulator?	
			Leak	Has the vacuum level dropped?	
		Main contact part	Damage	Is the contact rough?	
				Are there any issues with the arc extinguishing chamber of the air contactor?	
		Opening and closing indicator and opening and closing indicating light	Operation	Does it work normally?	
		Opening and closing meter	Operation	Does it work normally?	
		Control device	Damage	Are the springs damaged or deformed?	
				Is the connecting pin damaged or causing a short circuit?	
				Is there any abnormal sound coming from the electromagnet?	
			Operation	Is the auxiliary switch functioning properly?	
		Low pressure control circuit	Looseness	Are any bolts loose in the control circuit terminal unit?	
			Contact	Does the plug of the low-pressure control circuit make good contact?	

6. INSPECTION AND MAINTENANCE

6-5 Regular inspection items

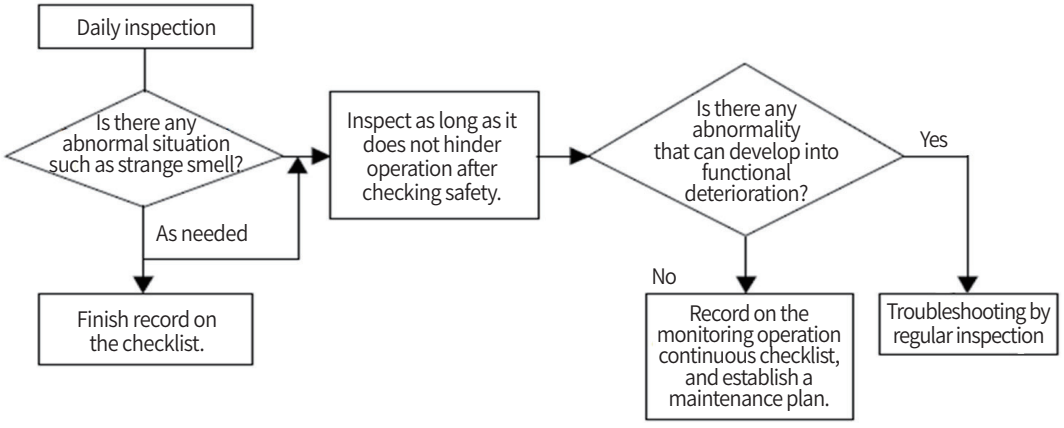
2) Built-in device, accessory device

No.	Target	Inspection point	Purpose	Inspection details	Notes
17	Low pressure electronic contactor	Appearance	Looseness	Are any bolts loose in the terminal unit?	
			Damage	Is the insulator cracked, damaged or deformed?	
			Discoloration	Is there any discoloration on the terminal and contact due to overheating?	
			Stain	Are there any foreign objects or dust attached to the insulator?	
		Main contact part	Stain	Is the contact rough?	
				Is there anything wrong with the arc extinguishing chamber?	
		Control device	Operation	Is the opening/closing operation normal?	
			Indication	Is the opening/closing display normal?	
			Damage	Are the springs damaged or deformed?	
18	Fuse for control circuit	Outside	Looseness	Is the terminal part loose?	
			Operation	Is the part cut off?	
19	Accessory device	Cooling fan	Stain	Are the filter and ventilation opening damaged or have fallen on the floor?	
20	Spare parts	Indicator light fuses	Damage	Are there any cracks, disconnections, or other damage?	
			Quantity	Are there any extra quantities available?	
		Other items		In comparison with the table of quantities and spare parts, the estimated spare parts for each product are listed each time.	

6. INSPECTION AND MAINTENANCE

6-6 Troubleshooting

1) Troubleshooting by daily inspection



2) Troubleshooting by regular inspection

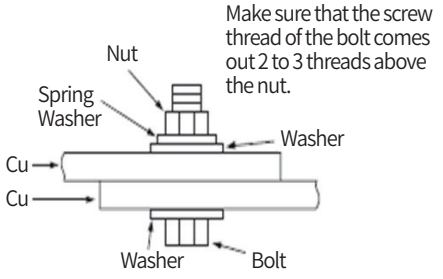
No.	Handling	Methods and precautions
1	Cleaning	1. The suction method is recommended if air is used. Be cautious of air humidity and pressure when using the extraction method. 2. Remove dust or foreign matter or objects from the top of the switchboard before opening the door or cover. 3. Clean the insulator in a direction that crosses the live parts. 4. Use a chemically neutral cleaning cloth, and be cautious of moisture if the fiber strands are loose.
2	Tightening of bolts (bus bar)	For bus bar follow the method below: **1. Tightening method** Use the specified materials and parts correctly for tightening, and connect while following the points in (4) below. (1) Tighten bolts with the prescribed torque using a torque wrench applicable to the bolt size. (2) Tighten the bolt by turning the nut. (3) When using more than two bolts, do not overtighten only one side.

6. INSPECTION AND MAINTENANCE

6-6 Troubleshooting

2) Troubleshooting by regular inspection

<table>
<tr><th>No.</th><th>Handling</th><th>Methods and precautions</th></tr>
<tr><td>3</td><td>Tightening of bolts
(bus bar)</td><td>
(4) Tightening torque
<table>
<tr><th>Bolt specification</th><th>Torque (kg f · cm)</th><th>Bolt specification</th><th>Torque (kg f · cm)</th></tr>
<tr><td>M6</td><td>70 -100</td><td>M12</td><td>600 - 850</td></tr>
<tr><td>M8</td><td>200 - 245</td><td>M16</td><td>1500 - 2040</td></tr>
<tr><td>M10</td><td>350 - 490</td><td></td><td></td></tr>
</table>
◈ CU (copper) and Al (aluminum) are the same.
◈ Torque tolerance is - 0 % to +22 - 42 % (applying maximum tightening torque).
◈ For the strength of M6 or bigger bolts (spring washers), apply 8.8 (hightensile bolts).

2. Connection method


3. Verifying tightening
There is a risk of accidents if the tightening torque is insufficient or the tightening work is not properly performed. Therefore, it is necessary to verify that the prescribed torque is applied using a torque wrench. Place check marks on the nuts and bolts as shown in the figure below. Since the blue check marks are placed at the factory, use red to indicate confirmation.


</td></tr>
</table>

6. INSPECTION AND MAINTENANCE

6-6 Troubleshooting

2) Troubleshooting by regular inspection

<table>
<tr><th>No.</th><th>Handling</th><th>Methods and precautions</th></tr>
<tr><td>4</td><td>Tightening of bolts (structure)</td><td>Refer to the torque values below when fastening a structure with bolts.
<table>
<tr><th>Bolt specification</th><th>Torque (kg f·cm)</th><th>Bolt specification</th><th>Torque (kg f·cm)</th></tr>
<tr><td>M5</td><td>30 to 40</td><td>M10</td><td>240 to 300</td></tr>
<tr><td>M6</td><td>50 to 65</td><td>M12</td><td>420 to 530</td></tr>
<tr><td>M8</td><td>120 to 150</td><td>M16</td><td>1050 to 1300</td></tr>
</table>
However, insulators have different torque values.</td></tr>
<tr><td>5</td><td>Repair of insulating materials</td><td>1. If the magnetic insulator is damaged or contaminated with foreign matter or objects, clean it according to Handling 1 (Cleaning).
2. If the synthetic resin laminated board or wood is old and loose, replace the parts by according to Handling 5 (Parts replacement).
3. Even if the insulator is cracked, damaged or deformed, also replace the parts according to Handling 5 (Parts replacement).
4. Dry reactor
<table>
<tr><td>Voltage (kV)</td><td>Under 1</td><td>3</td><td>6</td><td>10</td><td>20</td><td>30</td></tr>
<tr><td>Insulation resistance (MΩ)</td><td>5</td><td>20</td><td>20</td><td>30</td><td>50</td><td>75</td></tr>
</table>
5. Inflow reactor
6. Insulation resistance between terminal group and enclosure (MΩ): 100
7. Condenser for power
8. Insulation resistance between terminal group and enclosure (MΩ): 100</td></tr>
<tr><td>6</td><td>Parts replacement</td><td>1. When replacing parts, thoroughly check the form and function.
2. Be cautious of loose connections, and remember to tighten the bolts when replacing parts.
3. If the part requires adjustment, adjust it properly after replacement.
4. Soldering work should be carried out by skilled workers.</td></tr>
</table>

6. INSPECTION AND MAINTENANCE

6-7 How to take qctions when an error occurs

No.	Error detail	Probable cause	Actions	Notes
1	Breaker doesn't work	- Loss of control power; - Lack of control power; - Protective relay is activated; - Incorrect operation position selection	- Keep MCCB for control power on; - Check whether the input voltage is normal; - Reset protection relay operation; - Check the selection switch (Local/ Remote)	Refer to the User Manual for the breaker
2	No breaker incoming/ withdrawal	- Foreign matter/objects insertion; - Guide rail transformation; - Poor mechanism	- Remove foreign matter/objects; (Contact our A/S team)	
3	Discolored connection part	- Loose bolt; - Overloaded	- Tighten bolts after power off; - Maintain proper load	
4	Protective relay malfunction	- Loss of control power; - Lack of control power; - Failed to reset the relay	- Keep MCCB for control power on; - Check whether the input voltage is normal; - Reset the relay	Refer to the User Manual for the protection relay
5	Indicator malfunction	- No instructions	- Replace the indicator; - Check input fuse	
6	Defective indication and failure lamp operation	- Burned-out lamp; - Loss of control power; - Defect persists	- Replace the bulb; - Check whether the control power MCCB is on; - Check the circuit diagram	
7	Close/open operation failure	- Defective selection switch	- Replace the selection switch	Refer to the User Manual for the auxiliary relay
8	Auxiliary relay malfunction	- Defective product; - Stuck with foreign matter/ objects	- Replace the auxiliary relay	
9	Abnormal noise	- Poor tightening of bolts; - Poor device attachment	- Tighten bolts after power off (Tightening to the prescribed torque)	
10	Fan malfunction	- Foreign matter/objects insertion; - Loss of control power;	- Clean after power off; - Check whether control power MCCB is on; - Replace the fan	

DISPOSAL

7. DISPOSAL

7 Disposal

1. Ferrous and non-ferrous materials (liquid) should be separated from the entire switchboard.
   Environmental pollutants and reusable materials should also be separated before disposing of them at designated locations.
2. If you wish to reuse product materials, please contact us.
3. When incinerating this product, it may emit toxic gases that can cause respiratory problems. Make sure to dispose of the product at approved locations.

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